



ON THE ECOLOGY AND ETHOLOGY OF BLACKBUCK ANTELOPE  
SERVICAPRA, (LINNAEUS) AND THE CHITAL AXIS AXIS, (ERALEBUN)  
AT THE GUINDY DEER SANCTUARY

4  
BY

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## 1. INTRODUCTION

India is endowed with a rich diversity of habitats. Coniferous wet and dry Evergreen, tropical and deciduous forests, scrub zones, marsh lands, deserts each with its own unique faunal and floral assemblage. There are 500 species of mammals in India distributed in the various habitats. These rich variety of habitats has been reduced and exploited during the past 150 years and with it, the animals populations have also been reduced. This shows a lack of ecological understanding. Rice (1857), Jerdon (1874), Baker (1890) all speak of the huge animal populations that were once present in India. Champion (1953) was among the first to express the plight of India's wild life. Gee (1963) brought public notice to the perils it faced.

Only recently has the importance of ecology been realised and the necessity of studying animals in their natural habitats in terms of population, behaviour, and in relation to the vegetation. Surprisingly, in spite of the remarkable variety of mammals present in India only recently have scientific studies on the bigger mammals been undertaken in India. The major studies include Schaller's (1967) work on the tiger and the major ungulates of Kanha, National Park De A Spillet (1971) on the Chital at Corbett, National Park Berwick & Jordan (1971) on the Ungulates of Gir, National Park Sharatchandra and Gadgil (1975) on Chital, elephant, wild dog at

Bandipur, National Park Krishnan (1975) survey of the large animals of Peninsula India and Ali (1979) on Sambar at Masaribagh, National Park. The Guindy Deer Sanctuary is a remnant of the Scrub jungle that abounded with native animals such as Blackbuck (Krishnan, 1975) Leopards and Python (Whitaker, 1971) around Madras. Fortunately at least 619 acres of this vegetation has been preserved. A sizeable herd of Chital, India's commonest deer and Blackbuck, an antelope unique to Peninsula India, together with other native fauna are found here. The Sanctuary is an excellent living laboratory for field work though not totally natural now.

The present work is an attempt to study the behavioural ecology of Blackbuck and Chital. This work seeks to analyse their basic behaviour patterns, herd structure, population and feeding behaviour in relation to the park.

## II. STUDY METHODS

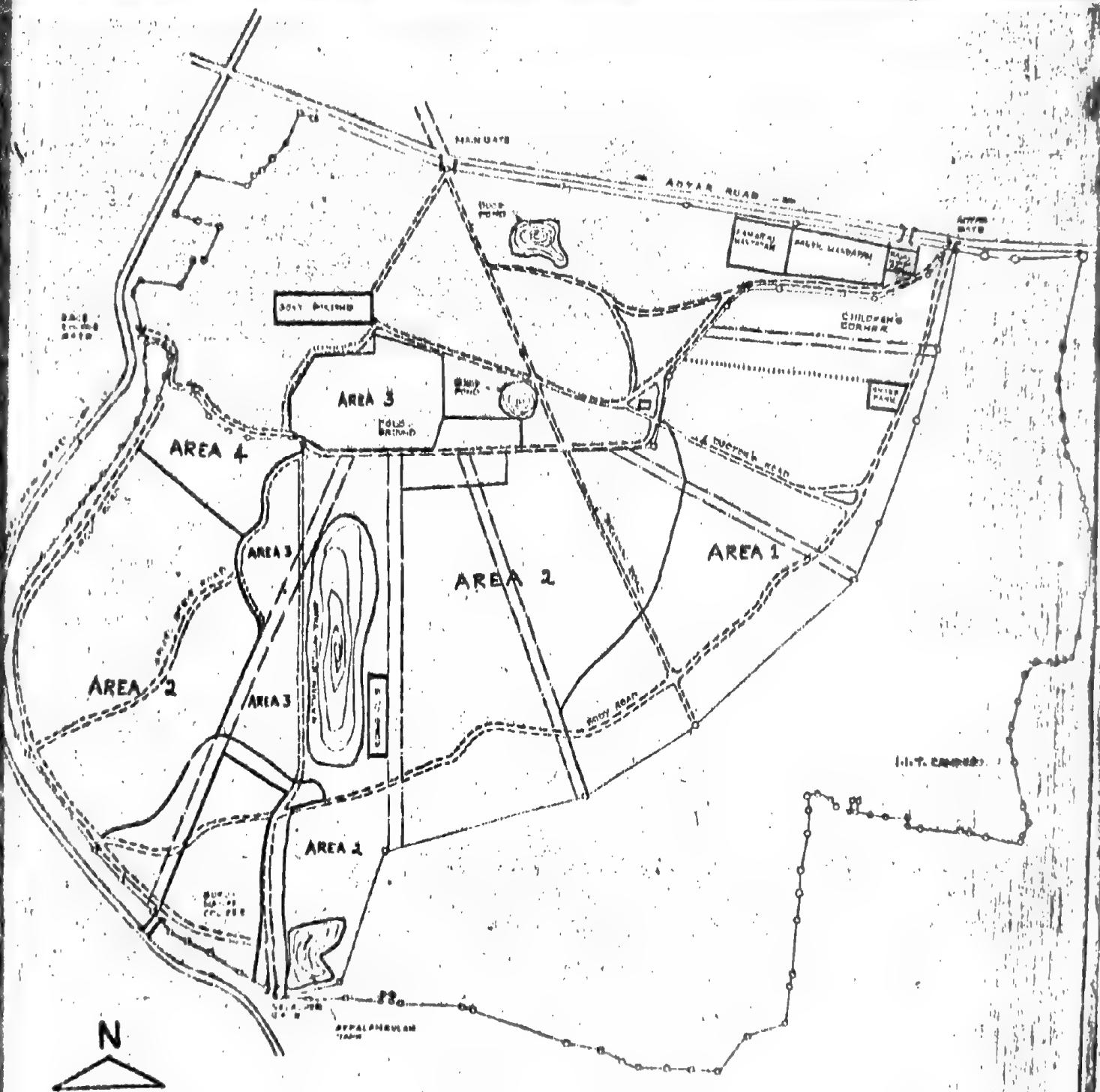
Observations were made on foot with the aid of 7x50 binoculars from a distance of 100 - 300 feet. On an average 10 hours was spent every week in the field, throughout the study period. The study was restricted mainly to two days of a week, though holidays were also utilised. The study began on October 1977 and ended on March 17th 1979.

Observations began around 0630 hours and ended at 1400 hours or were carried out till 1830 hours. Though all parts of the Sanctuary were covered, the major part of the observation was done at the polo field (Figure 1), especially with references to study on the Blackbuck. The method adopted was 'Focal study'. For this five mature males were selected and observations recorded on territoriality, herd association, and feeding time budget. Observations on other members of the species also done.

For Chital, focal study was not undertaken. But identification of males and females wherever possible was made and their positions marked on a map. Individual herd composition, structure, and associations, for each encountered, was observed.

In areas, other than the polo ground care was taken to remain conceal from the animals and if detected observation was terminated. For a study of feeding habit after observing directly on which plant the animal was foraging, the plant was then collected and identified with the help of Gamble (1935). For population studies all

animals encountered were classified as to sex and approximate age, its herd structure and composition was noted and position marked on a map. One census was conducted during the period of study. Specific methods as classification of animals into age classes are given in the text.



## GUINDY PARK RESERVED FOREST

LEGEND  
AREA 1 - GOOD CANOPY, ACACIA PLANIFRONS DOMINANT  
AREA 2 - SEMI-OPEN AREA  
AREA 3 - OPEN & CLEARED AREAS  
AREA 4 - ACACIA SUNDRA PRESENT

SCALE 1 MILE  
(20000 ft)

### III. DESCRIPTION OF THE SANCTUARY

The 619 acre Sanctuary is situated within the city limits of Madras and is adjacent to the 260 acre Raj Bhavan with no boundary in between. The Guindy Park represents a thorn-Scrub jungle, typical for much of the Southern arid zone of India (Spillet, 1966).

There are about 200 species of trees, shrubs, climbers, herbs, sedges and grasses, both indigenous and exotic. Species characteristic of the local vegetational Scrub jungle are Randia amara, Carissa spinosa, Fleugertia, Toddalia asiatica, Peronia elephantum, Zizyphus xylotropus, Pteropeltachys cinerascens.

Even within such a comparatively small area, there is a surprising diversity in the pattern of the vegetation. There are thickly forested areas, semi open areas, and open areas. In addition there are two tanks occupying 76 acres of the Sanctuary but much of which is dry during summer. There are also two temporary ponds. The entire Park has been divided into four areas based on the canopy and dominant trees present. (Figure 1).

#### AREA I

This area is thickly forested with a good canopy. The dominant tree is the umbrella shaped Aegiphila planifrons. The undergrowth is dense with the shrubs Glycosmis cochininchinensis and Glycosmis willdenowii.

## AREA II

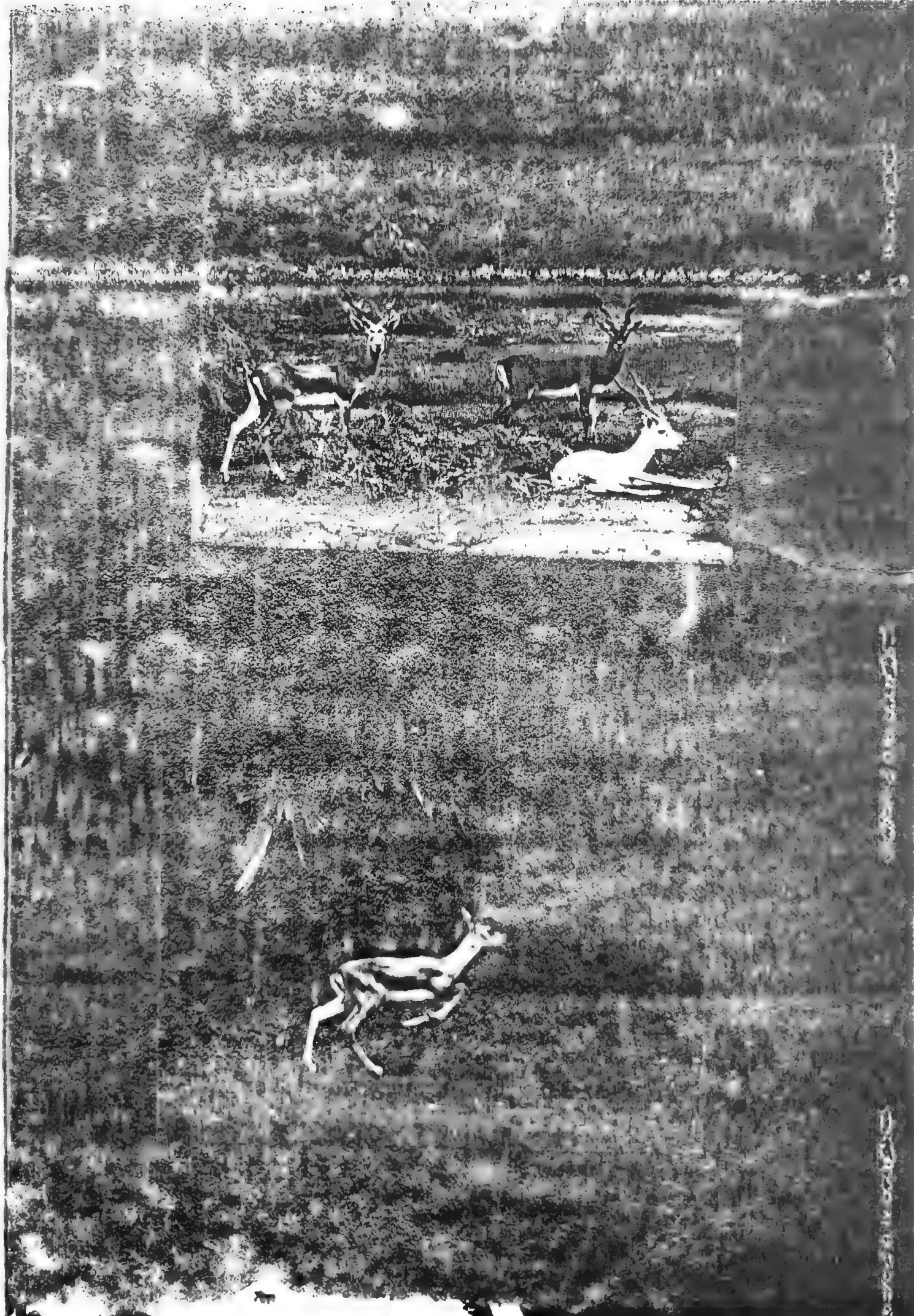
In the semi open areas, Acacia planifrons is almost absent and the canopy is sparse. Although no species is clearly dominant the palm Areca catechu Simellifer is conspicuous, and so also the shrubs Dodonaea sp. and Bendix sp. This forms a major part of the Park.

## AREA III

This represents the areas which have been primarily cleared and in some cases have also been planted with saplings of trees within brick enclosures. The polo field is about 180 x 135 and open ground and carpeted with herbs and grasses, chiefly of 16 species.

## AREA IV

The extreme west of the Park probably has the remnant of the original vegetation of the region. The vegetation fully thick though not as much as Area I. Annona flavunda is characteristic, along with exotic Cactus cerus. The vegetation of the area is important as canopy, undergrowth, and open areas decide the distribution of Chital and Blackbuck within the Sanctuary.



## IV. THE BLACKBUCK

## 1. DESCRIPTION

The Blackbuck (Antilope cervicapra) is the sole representative of the Genus Antilope and with the Chinkara or Indian Gazelle (Gazella gazella) represents the Family Antilopinae in India. Four sub species are recognised by Ellerman and Morrison-Scott (1951). Of those Antilope cervicapra rajputanae in Rajasthan and Punjab, Antilope cervicapra rupicapra in Uttar Pradesh Eastward and Antilope cervicapra cervicapra in southern India, and Antilope cervicapra centralis in central India.

The blackbuck are graceful medium sized antelopes adapted for life in dry open plains and scrub. A remarkable feature is the marked dimorphism in coat colour between the sexes and is one of the few antelopes to exhibit such a difference.

The adult bucks stand about 73 to 83 cm. high at shoulder and their total length is 120-145 cm. The weight of the adult varies from 30 Kg to 40 Kg, while that of does between 30 to 35 Kg. (Johnson, 1976). In adult bucks the face, neck, back sides and upper side of legs are black. A white ring surrounds each eye and a small white patch is seen from the corner of eye. The chin, chest, side on, rump, and the insides of legs are white. There is a clear margin where the white meets the black on the sides. The nape is rusty. The horns are marked with rings and have 3 to 4 1/2 spirals and are about 30 to 35 cm.

Does, fawns and subadult males are light brown where the adult buck is black. Many does also have a faint white line on its side in addition to the line formed where brown meets white. (Figure, 2).

Yearling males have horns with no spiral. An open spiral is developed by the end of the second year. It is believed that the full number of spiral twists is attained with the dark coat about the end of the third year. (Prater, 1971). A few gray bucks and brown bucks with the full complement of spirals were seen. Bucks are said to undergo a conspicuous change of pelage (Schaller, 1967), but it does not seem to be very conspicuous here. There is only a slightly scruffy look and nape in many adult bucks become yellowish brown during summer and the coat increases its luster from July.

Horned females are said to occur (Prater, 1971) but no such case was recorded here.

The Point Calimero Sanctuary in Tamil Nadu was estimated to have a population of around 800 blackbuck (Daniel, 1967) but Hair (1972) estimated the population of only 350 animals. The population is said to be increasing in many parts of India. An isolated population existed or still exists in small numbers near Maninagudi area of Mudumalai Sanctuary (Krishnan, 1975). This population is extinct now but are now present on the border between Dheveniager and Thengaiyuram (Davidar, 1977). In Texas, U.S.A., Blackbuck has been introduced into rangeland and is thriving well (Ables and Ramsey 1974).

The population of Blackbuck at the Cuttuck Deer Sanctuary is estimated at around 260.

### 3. DISTRIBUTION WITHIN THE SANCTUARY

Even within the comparatively small area of the Guindy Deer Sanctuary the habitat preference of the Blackbuck is fairly well marked. It inhabits the open and semi open areas (Area II and Area III) particularly the polo ground. The Raj Bhavan area is also fairly well inhabited with Blackbuck. A few Blackbuck are also found in Area I, but this is mainly in the strip of land adjoining the IIT campus, where the undergrowth is not very thick. Seasonal changes in distribution were observed. While in the monsoon and winter months, the Blackbuck are mainly confined to their typical open habitat, in the driest summer months (mid March-June) they spread out to a certain extent to other parts of the Sanctuary in search of forage, and now the undergrowth is also thin.

The polo ground seems to be of special significance to the Blackbuck. This meadow not only provides food but is also a place where intense territorial behaviour was observed. During the dry months the forage is low in the meadow and consequently few animals are found grazing here.

During the summer months, when the K.K. tank becomes dry, a herd of Blackbucks mostly consisting of subadult males and one or two adult Blackbucks take residence on the bed of the lake and continue to do so till the pond becomes filled by the monsoon rains.

TABLE I

COMPOSITION OF BLACKBUCK POPULATION AS ESTIMATED ON 12.3.1972.

MALE		FEMALE	FAWN
Adult	30+ months Class V-23	Adults (includes subadults)	135 Male 4
Subadult-adult	30-38 months Class IV-12		
Subadult	24-30 months Class III-23	Yearling	17 unsexed 7
Subadult	16-24 months Class II-26		
Yearling	10-13 months Class I-13		
		Total	152
		97	11
			Grand Total = 260

TABLE II

BLACKBUCK POPULATION EXPRESSED IN PERCENTAGE

MALE		FEMALE	FAWN
Adult	Class - V	0.9% - 15.0% - 15.2	Adult (includes subadults)
Subadults	Class - IV II	23.5% - 4.2% - 4.0	17.8% + 7.5
Yearling	Class - I	5.0% - 4.4% - 0.1	6.5% - 80.7

— = GWF 1971

- = GWF 1992

#### 4. POPULATION DYNAMICS

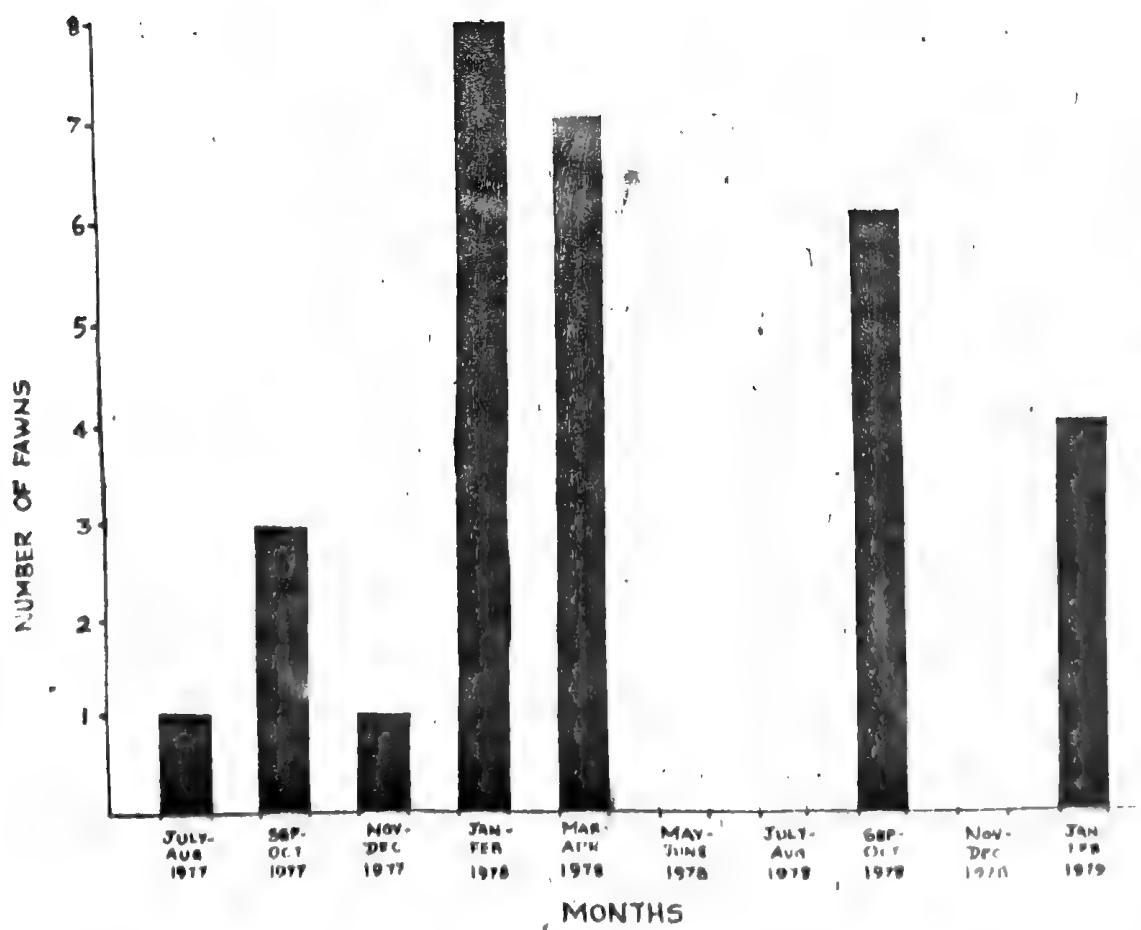
Based on counts throughout the study period and a census conducted on 17.3.79 a population of 260 Blackbuck has been estimated for the Guindy Deer Sanctuary.

Table I presents the general composition and Table II gives the same in percentage.

The bucks are divided into into 5 age classes based on body size, colour and nature of horns. Of the 97 bucks tallied 23 were fully mature and black and formed 8.9% of the population. Class IV bucks consisted of 12 grey bucks or maturing brown bucks and classes III and II consisted of 23 and 26 animals respectively. The three subadult classes IV, III and II made up 23.5% of the population. Class V consisted of 13 yearling bucks making 5.6 of the population. The female population consisted of 152 does since it was difficult to classify every subadult female, the subadult females were clumped with the adults. They consist of 135 animals and make up 51.9% of the population and the 17 yearling females making up 6.9%. 11 fawns make up 4.2% of the population.

Since 30 yearlings were present, they must have been born during the Sep to December 1977 or January to April 1978. But only 19 fawns have been encountered of which 3 died (Table III) one in 1977 and 2 in 1978 which otherwise would have survived to be yearlings. The remaining were either born prior to September, 1977 or the fawns were not counted.

## NUMBER OF FAWNS BORN DURING THE STUDY PERIOD



Taking the age of the yearling into consideration it is assumed that at least 50% of the remaining 14 had been born during October-November 1977 in addition to the three fawns noticed. The birth of the remaining yearling were either not noted or the yearling were older than estimated.

Note that only five fawns were born in the second half of 1977 and also of the 21 fawns born in 1978, 15 were born between mid January and March 1978 and six between September, October 1978 (Figure, 3). Also from the age of the majority of the bucks that fall within the two year class they must have been born between February and early April, 1977.

### III. BREEDING SEASON

The gestation period for Blackbuck is six months (Adolfi, 1964). Therefore the present 2 year olds were probably conceived during August-October 1976. In the yearlings, probably 17 were conceived during April, 1977 and the remaining 13 animals were conceived during August-September, 1979. At least five does were pregnant and also the bucks exhibited high territorial behaviour during August-October, 1978.

One (1976), Prater (1971), and Walker (1979) state that the February-March rut is the main rut, but Chittler (1967) noted that the August-October was the main rut at Kanha National Park.

It was noticed by estimating the age of individual animals, correlating birth of fawns, territorial behaviour, courtship and number of pregnant does, that though two peaks one in March and another in August-October was observed, the August-October seemed to be the more important one.

#### REPRODUCTIVE RATE

Achariyo and Misra (1973) noted that sexual maturity of two captive females was at one year 11 months and one year seven months. Schaller (1973) noted that sexual maturity of Blackbuck at Kanha at about 2 1/2- 3 years of age. Assuming about two years to be the age of sexual maturity of the female Blackbuck of Guindy then an estimated 40% of the 135 females were subadults. Then only about 70 females would have attained sexual maturity by the August-October 1977 rut.

One young per year appears to be the rule in the wild (Schaller, 1967). Then about 100 fawns must have been born in the course of the three ruts, though it was noticed that during the March 1978 rut, conception was low. But only 24 fawns had been encountered between February 1978 and March 1979 and at least six were pregnant in February 1979, making a total of just 30 fawns. This could be because the fawn was mortality was high or the fawns were missed during counting which is unlikely or that self-regulating population mechanism are in operation as discussed later. Disturbance can also be a contributing factor for the low natality rate, though rate of

TABLE III

MORTALITY IN BLACKDUCK

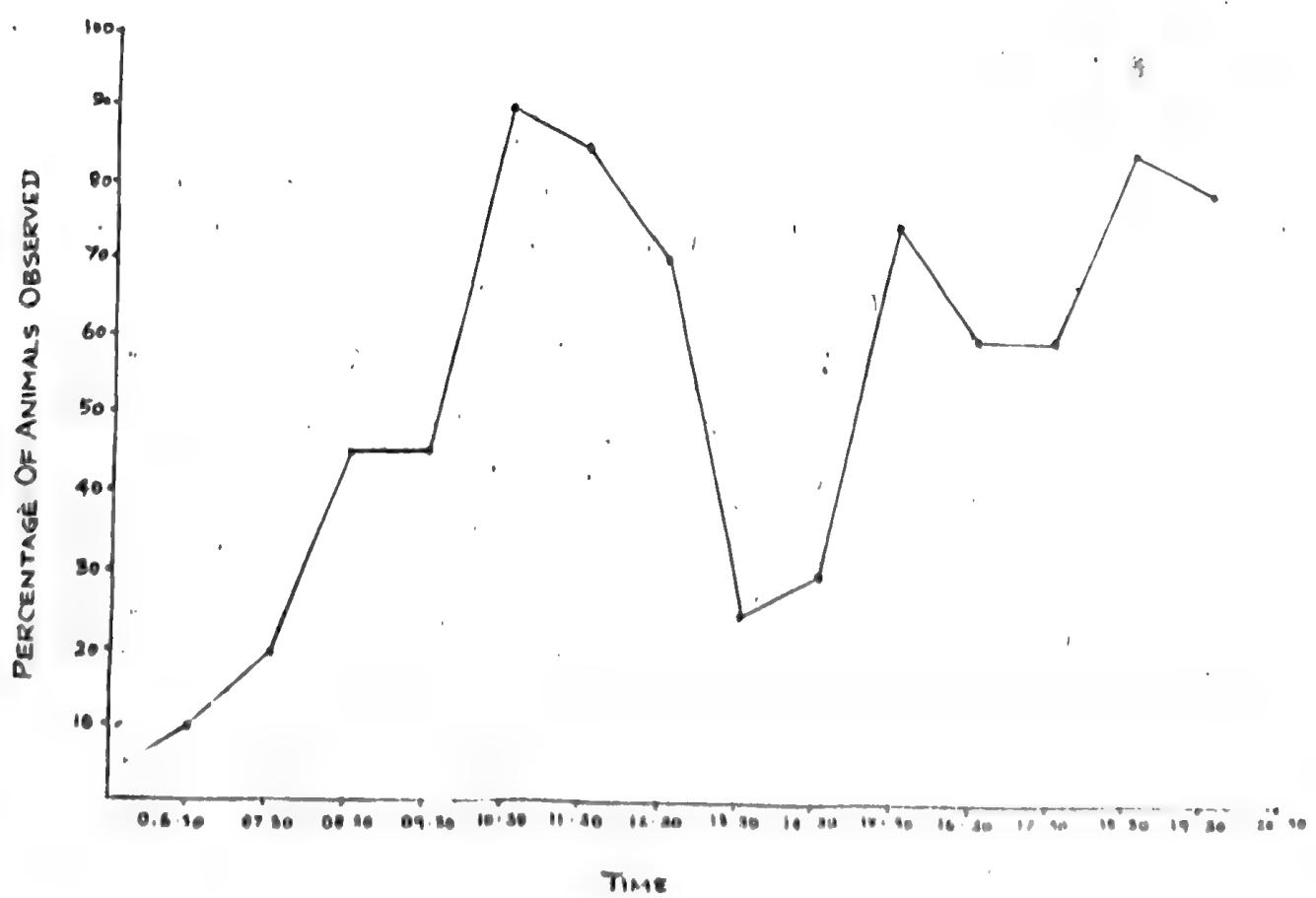
YEAR	MALE	FEMALE	FAWN
1977	2	8	5
1978	2	6	5
1979	-	1	-

turnover seems adequate.

#### MORTALITY

20 Blackbuck died during 1977-1978. (Table 3). Many died during the monsoon and one was found dead in Feb, 1979. A few died in summer also, probably due to lack of forage. The actual causes of death are not clear but many were observed dead after being injured by barbed wire or Jackals were observed during Sep, 1978 but what effect they had on the Blackbucks is not known.

## GENERAL FEEDING ACTIVITY CYCLE OF BLACKBUCK



## 5. DAILY ACTIVITY CYCLE

The Blackbuck is adapted to tolerate sunlight and is a diurnal feeder. Three peaks of feeding activity was observed (Figure.4) The animals begin grazing at 0700 hours and reaches a peak around 1000 hours to 1100 hours. Then there is a gradual decline from 1300 hours to 1430 hours and again reaches a peak at 1530 hours. After a slight decline, feeding again reaches another peak around 1800 hours and then a sharp decline was observed. Schaller (1967) records some night time feeding but they are at rest for most of the night.

Seasonal variations in feeding have been observed.

During the summer months, there is very little feeding activity after 1000 hours and a peak of feeding was noticed in the evening.

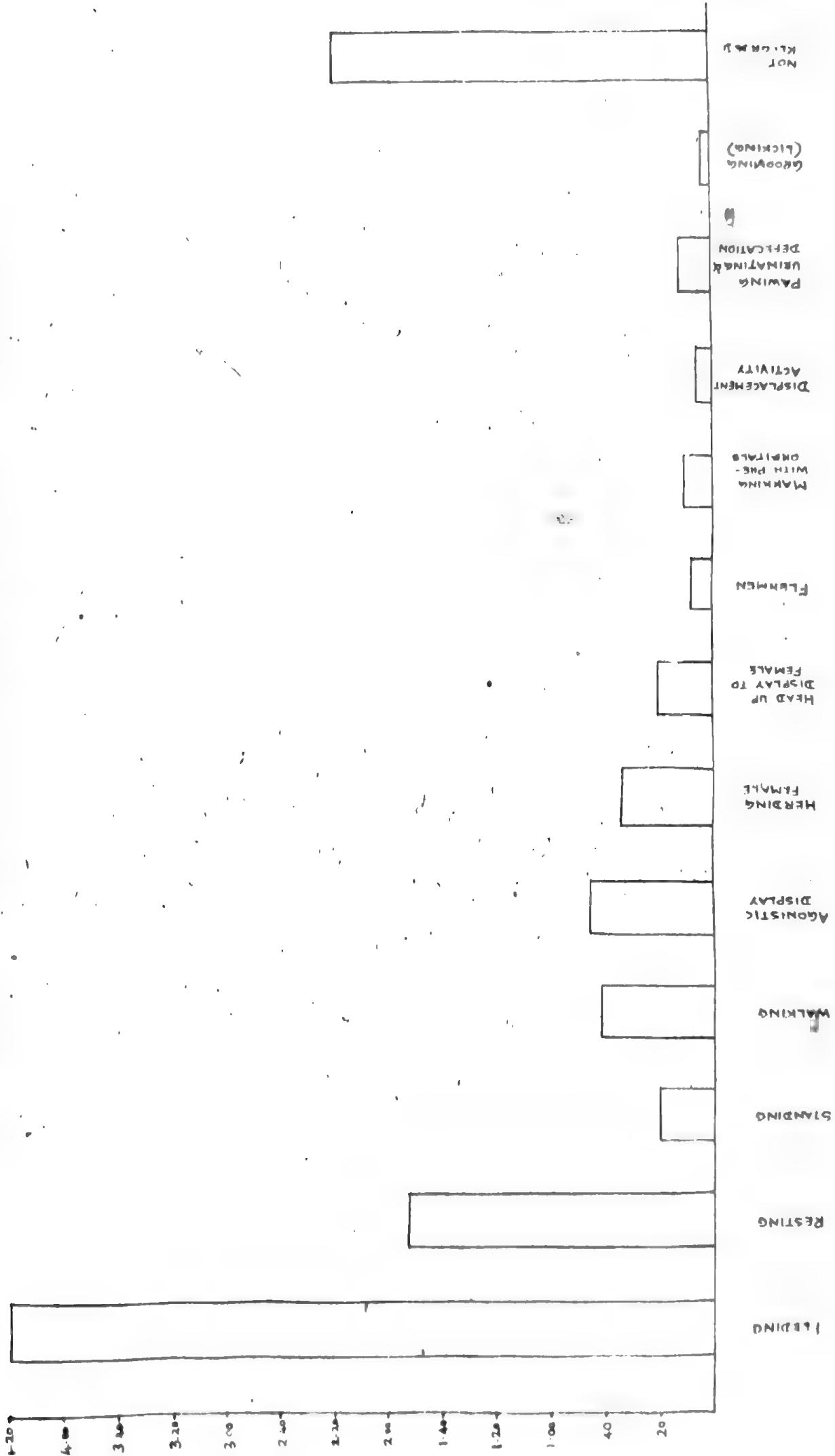
## MOVEMENTS

Animals were noticed to rest in the open during night but early morning they retire to the semi open area and again emerge by 0730 hours for feeding.

## TIME ACTIVITY

Females spend nearly half the time between 0600 to 1800 hours in feeding and the other half is utilised for resting and moving from one area to another. Mature males were seen to spend more time in the morning between 7.00 hours and 10.00 hours in feeding than females. Later they engage themselves in agonistic displays, hording marking and other activities. Seasonal variation were also observed for longer durations than females.

TIME BUDGET OF MALE BLACKBUCK RECORDED IN NOVEMBER 1978



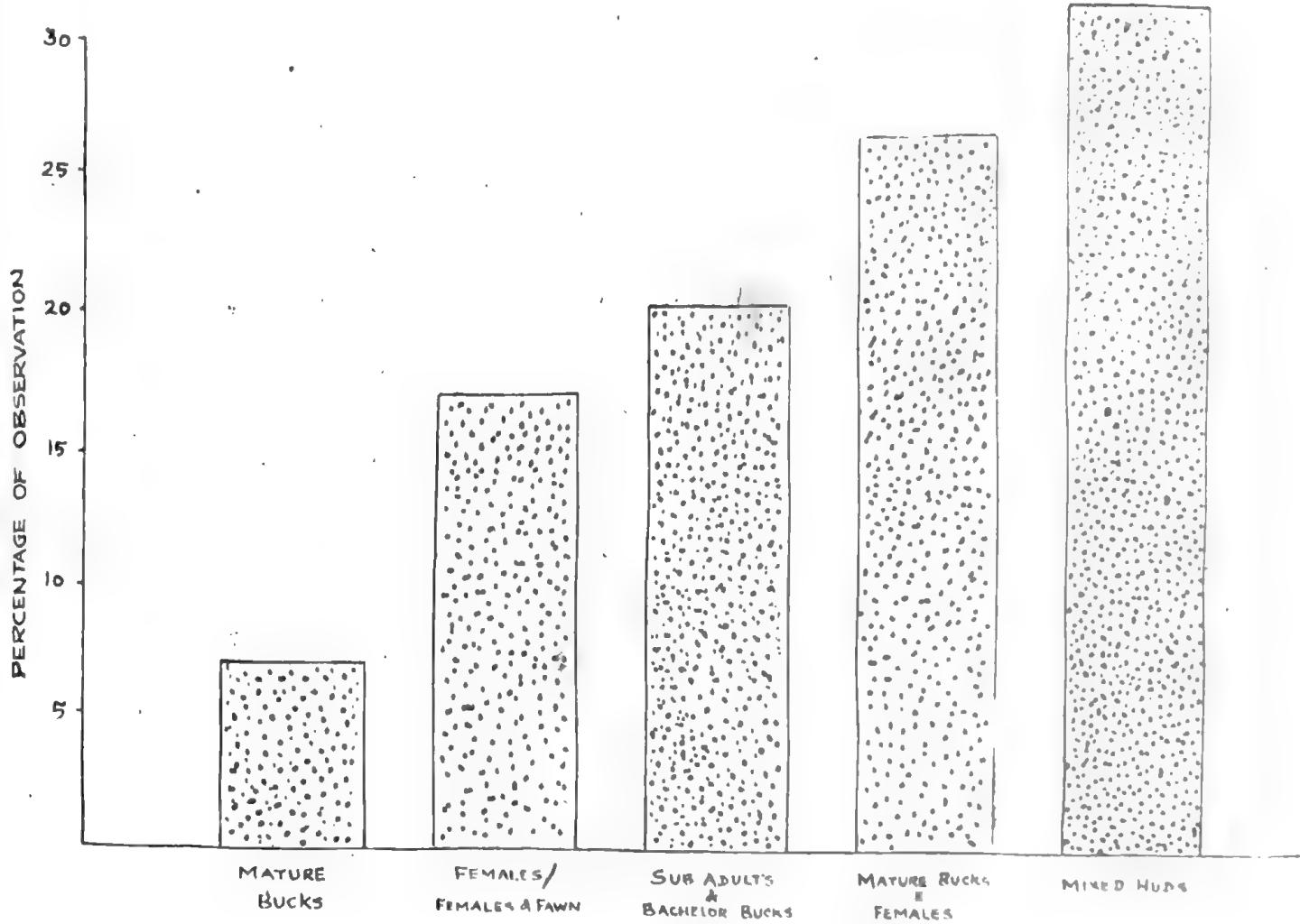
During the rut they seemed to feed less as they were actively defending territories, herding and displaying to females. (Figure. 5 ) shows a time activity budget of a male Blackbuck recorded on 31.11.1978. It can be seen here that nearly half the time is engaged in feeding and also herding activity is not very high as the rut was over, but males still exhibited territorial behaviour.

## 6. FOOD AND ITS

Blackbuck were observed to be primarily grazers feeding mainly on four kinds of grasses including Eleusine sp. The flowers of Dasisia longifolia are also eaten. The herbs Borreria hispida, Ludwigia sp., Leucaena leucocephala were also taken occasionally. In the summer months when food was scarce and the grasses were overgrazed they spread interior into the forest and pick up fallen leaves of Sicyphus xylopyrus, Aegle planifrons pods of Cynometra marginata and other fruits. But, these are only supplementary and the animals were seen to prefer grasses. The grass Alpha alpha provided for Chital in the summer months does not appear to be preferred as very few Blackbuck were seen at the feeding sites, though it is eaten during the driest period.

Schaller (1967) records no instance of drinking water, but drinking was observed here. In most cases it was the females and young subadult males that were observed drinking. Only once was a mature Blackbuck seen drinking.

## HERD COMPOSITION IN BLACKBUCK



## 7. SOCIAL BEHAVIOR

The social structure can be divided into five units. (Figure,6)

- 1) Mixed herds which consists of females subadults of both sexes and fawns. The female tend to dominate in number and the number range of 4-60 individuals.
- 2) Though the mature Blackbuck with 1-5 females form the second percentage of observation it was not consistent and females associated with males for short durations only.
- 3) Subadult bucks (Class II-IV) and bachelor bucks who have no territories formed herds which were highly consistent. One subadult group consisting of seven bucks and three more which later joined maintained the same composition and structure for more than six months. They were also seen around a given area and also moved for feeding and resting together. One or two yearling bucks also joined these groups.
- 4) The female formed loose aggregations and structure was not well defined except in the case of female and fawn yearling.
- 5) When not in rut or even during the rut, when foraging out of their territorial herds of two to four mature adult bucks were noticed. These aggregations were consistent in some cases in which a few bucks seemed to associate with other males during feeding but generally the association was loose. Seasonal variation were also seen.

The subadult herd was the most consistent and the next were female with fawns and mature territorial male with a female in estrus.

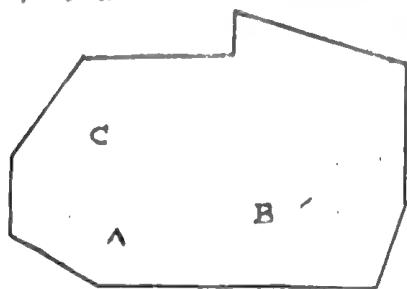
### SOCIAL ORGANISATION

Since the area occupied by the entire population is small almost all individuals interact with one another at one time or another. This was especially so at the polo field. Yet even within the field an organised structure was evident. The females and young form a herd while the subadult and bachelor bucks form another. The mature bucks were observed either feeding alone or on with other males.

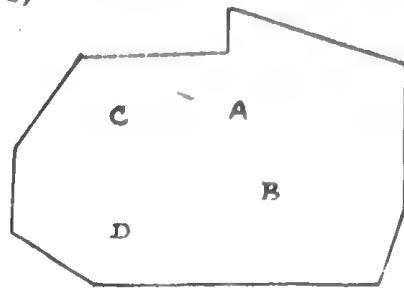
The intruding male population was observed to take position around the periphery of the field and went towards the centre of the field when the mature males were either not present or when the rut was over. Thus by forming close knit groups each herd knows the relative dominance of its members and probably members of other herds when they repeated meet and serious fighting would be reduced. An important aspect of dominance is that it operates to make close societies? (Etkin 1964). Subadult sparring is different from the actual fighting of adults. In sparring the horns are just locked and the animals try to push one another and foreheads often touch, and also the sparring period is long and interchange of sparring members frequently occurs. Of the 127 sparring matches recorded 50% of it lasted for more than two minutes each. The sparring being almost continual and in 70% of them they changed partners. 60% of the sparring consisted between animals of the same class and the

BLACKBUCK MALES OCCUPYING TERRITORIES AT POLO FIELD  
AND CHANGES THAT OCCURED BETWEEN 15-8-77 TO 4-3-79

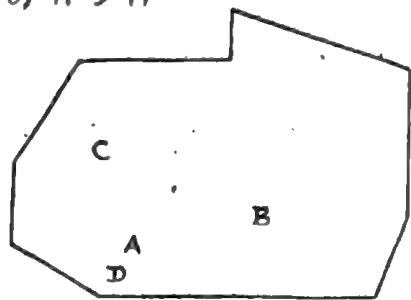
(a) 15-8-77



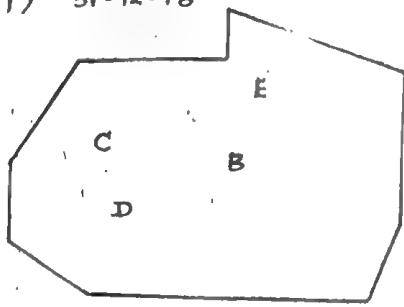
(e) 27-10-78



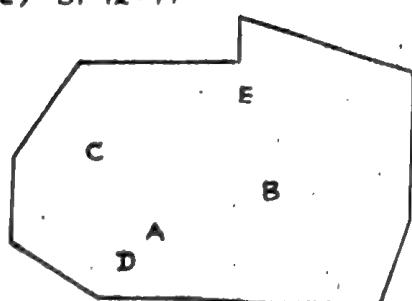
(b) 11-9-77



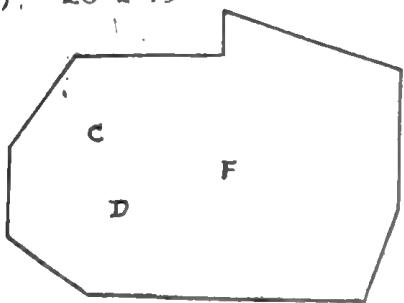
(f) 31-12-78



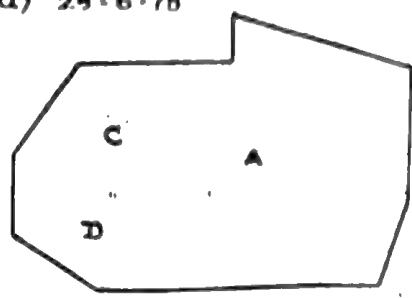
(c) 31-12-77



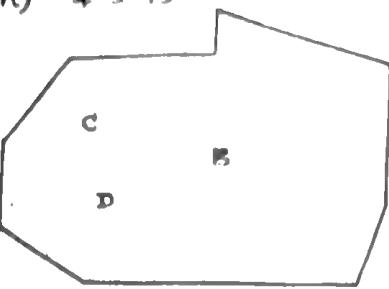
(g) 28-2-79



(d) 29-6-78



(h) 4-3-79



rest was mixed. Occasionally a territorial male briefly took part. On eight occasions three animals were seen sparring together.

#### TERITORIALITY IN BLACKBUCK

The polo field an area of 100 x 135 metres is of special significance to the Blackbuck of Guindy. Five bucks were observed consistently from the start of the study and on these five focal study was made by identifying them by individual morphological differences and also upon the relative position in the field. The position and changes that occurred in the territories during the study is given in (Figure, 7). Each territory consisted of about 30 x 30 mtrs.

When study was started only three animals were present Buck A, Buck B, Buck C, later on 1.9.1977 a new buck took up a small area on the eastern half of the field next to Buck A. The frequency of interaction between Buck A and Buck D was noted. Initially Buck D was driven off the field by Buck A with only a mild head down or the aggressive walk but later actual fights were recorded which increased in frequency. A total of 21 fights were recorded. Each of those lasted for about 3 minutes and this fighting was different from the sparring matches of subadults. Here the two opponents stand apart by about two to three foot and vigorously clash horns and separate. An average of nine clashes per fight was noticed. The two animals often show displacement activity by feeding briefly for about 40 seconds or more before clashing again. Buck A was still dominant until 1.1.78 when it chased Buck D out of the field but on 25.3.79 Buck D was successful in establishing a territory near that of 100 acres. Buck A had to move towards the centre. There was little

TABLE IV

AGONISTIC INTERACTION BETWEEN THE BUCKS AS RECORDED BETWEEN  
OCTOBER 1970 TO THE END OF JANUARY 1972

Mature male blackbuck	A	B	C	D	E
A	-	-	19	-	-
B	16	-	-	-	-
C	-	-	-	-	-
D	-	14	-	-	3
E	-	-	-	-	3

interaction between Buck A and Buck B probably as both were neighbouring animals for a long time. Neighbouring males rarely fought except during October 1978 to January 1979 when 52 agonistic interactions were recorded (Table 8) of these 19 was between Buck A and Buck C and 16 between Buck A and Buck D. Buck B interacted with Buck D on 14 occasions. Buck B interacted with a new male E on 3 occasions. 80% of the fights occurred near the eastern side of the field and 60% of it was between 1500 hours - 1830 hours. Buck E did not seem to interact during the period. On 28.2.79 it was noticed that both Buck A and Buck B were absent but new comer Buck F had taken up territory, and on the same day it was observed that Buck B exhibited redirected aggression nine times on a bush near the periphery of the field, and Buck F exhibited highly intensified territorial behaviour. But when work terminated on 17.3.79 Buck B was again at the centre of the field and was the only male that exhibited territoriality. This is probably the reorganisation (Schallor, 1967) noted at Kanha National Park.

#### DISPLAYS ASSOCIATED WITH TERRITORIALITY

A number of behavioural patterns connected with territoriality have been recorded.

**Standing:** The Buck with its conspicuous rump was often observed standing near the centre which itself was a visual marker and an indication of dominance in the territory.

MARKING

With proorbitals two types of marking with the proorbitals have been recorded.

- a) In this the male walks up to a dry twig and gently inserts it into the proorbital glands, smearing it with secretion for five seconds. The marking is made in four or five different places, in the territory but not necessarily on the same twig.
- b) In this marking the head low on the ground and thrashed slowly with about ten head movements.

DEFECATION

This is a fixed action pattern in which the animal first scrapes the ground with its forefoot about five times and then with an exaggerated posture by stretching its hind legs, horns laid parallel over the back, it urinates and then squatting very low it defecates. This posture is slightly different from the normal urinating and defecating posture. It was observed that this was done only during the rut in August-October and to lesser extent in March-April (1977). It was also noticed that in 80% of the observation this characteristic was exhibited only when other males were present. Also on one observation period of 45 minutes 16 sparring, urination and defecation were observed in September 1977 which clearly indicates the notion is ritualized and the characteristic body posture itself may be a marker. No dung piles were observed as noted by Daniel (1967) nor did it seem to exhibit a preference for a particular place as

noted by (Schaller, 1967). But this would be because the area is very small and dung is scattered all over the place though clumps of dung was noticed.

### AGONISTIC DISPLAYS

These consists of three displays.

#### Agonistic walk and head up display

The relative dominance increases with the centre and as another male approaches the territory the male raises his head high so that the patch of white on the chin shows clearly, the tail is held high or curled stiff gait.

The ears are also folded down. 'This type of an Advertisement' posture as the ear being folded down gains a conspicuance by its non-adaptive character as the ear does not point to the source of sound and it in marked contrast to the mobility of the ears of the other animals in the group. (Atkin, 1964).

Usually this characteristic walk itself elicits a response from the intruder by swerving away.

#### Head down

If the above display does not produce the desired response, the head is brought down with horns pointing down to the intruder and at the same time it walks aggressively. This will normally deter the intruder as was observed. In the 22 head down recorded 18 produced the desired effect and only in four did the displaying animal actually

pursue the intruder which was in all four cases an intra or belonging to the class IV Group. Here with head lowered the buck chased the intruder out of the area and poked it either in its rump or flank.

After chasing an intruder it was observed that the animal on many occasions followed an action pattern of marking with preorbital glands, scraping with hoof, urinating and defecating.

#### Herding:

This can be divided into, two components a) the actual herding of a female, in which females approaching a male's territory is approached by the male with a head up and the animal grunts. (Schaller, 1967). Records of grunting during the agonistic head up, but grunting here was usually associated only with herding display, if the female does not stop it actively tries to retain her within its territory by moving between the female and the edge of next territory. When the female stays within the area it walks upto her and standing parallel to her side does the second component of the display.

b) In this component the head point upwards and neck stretched so that the horn tips go below the back. It lasts for about four seconds and is repeated from two to seven times.

These herding displays were only observed within the territories and when females failed to stop to the displaying males it was noticed that it was rarely pursued after it had crossed the males territory. It was also observed that female walking through the field was chased

and displayed successively by all the males through whose territory the females pass. But the displays stopped at the end of the territory. One female in oestrus was seen to be chased by all the males but Buck D succeeded in herding it upon which all other males retracted hurriedly.

### SEXUAL BEHAVIOUR

Actual mating was never observed but courtship was seen on six occasions. All the courtship display occurred within the territory and almost at the centre of it.

· Males tested the breeding condition of females by exhibiting 'Flehmen'. In this action urine on the ground is sniffed and then with head raised high and lip curled it tastes it. On seven occasions a buck was observed to mark with its preorbital after exhibiting flehmen. If a doe was in oestrus it follows it and with stretched neck, head held high and horns below back, it pushes its neck on her rump. On all the observed occasions the female moved away.

This courtship action and the second component of herding display probably combines the aggressive head up display as well as the submissive action by putting its horns tips well below the back which is the opposite of the aggressive head down. But, it must be noted that no appeasement head down display by a subordinate buck directed towards a dominant buck as noted in the Dorcas gazelle *Gazella dorcas* (Smith, 1971) was noted.

### MALE AND FEMALE RELATIONSHIP

The courtship and herding display was discussed earlier. According to Hair (1972) Prater (1971) blackbuck possess and protect a harem, but no such harem was noticed. The female herd was very fluid and their number and individuals associating with the territorial males were observed to change from day to day. Excepting a female in estrus which may be followed by the male and herded back if she left the territory. On all observations females were herded by whichever male's territory they intruded. This agrees with Voss (1976) who states that till date there is no evidence of antelopes having a harem, but it could also be because of the highly compressed nature of the territory.

### FEMALE-FEMALE AND YOUNG RELATIONSHIP

Among the females no overt interaction was observed. The female young relationship seemed to be the strongest licking rump of young by females was observed on 22 times, and a contact call by the female to its young was also heard.

### VOCALIZATION

Three vocalizations have been recorded, GR RINGO : This is done by the territorial males only and is part of herding display.

GR RINGO : This was also exhibited usually by males and is probably an alarm call or caused by disturbance.

GOH : A soft but harsh sound was exhibited when the female was searching its young.

### RAPID GROWL AGGRESSION

When mature males of equal strength exhibited agonistic intent against each other it was either in the form of ritualized threats or direct fighting occurred. It was also observed that the aggressive motive was exhibited by thrashing violently on a bush. This is redirected aggression. This behaviour was also recorded on thirteen occasions. When a newcomer buck F appropriated, "took" his territory for a few days Buck B was seen repeatedly thrashing near the periphery of the territory against bushes. Four displays of redirected aggression by Buck B was recorded in a half an hour period. On other occasion when Buck F was courting a female a subadult buck belonging to class III came near and B instead of making agonistic displays to it, it redirected the aggression unto a bush. This action also seems to take place when men disturb the animal. The action depend upon the adversary, context, lasted from one to three minutes.

### APPEASING DISPLAY

When two mature interacted aggressively, they often walked parallel and close to each other with slow deliberate stiff steps and with head moving slowly from side to side for about 200 feet. When one wanted to clash the other presented its broadside which inhibited the attack. This position was maintained even when the other changed position so that the two made an arc. After about four minutes, the

two start cropping closely and no interaction follows. Only on two occasions did a buck actually swerve around so that it faced the opponent and clashed horns six times. On both the occasions the other male left the area. Mounting by dominant male as recorded by Schaller, (1967) was not observed.

#### DISPLACEMENT ACTIVITY

Associated with agonistic behaviour is displacement activity in the form of cropping. This was seen only when mature bucks or when adults of class IV animals fought. After clashing two or three times they go apart and feed for about one to two minutes before resuming clashing. This displacement is probably brought about by the tension caused when two equally powerful animals fight.

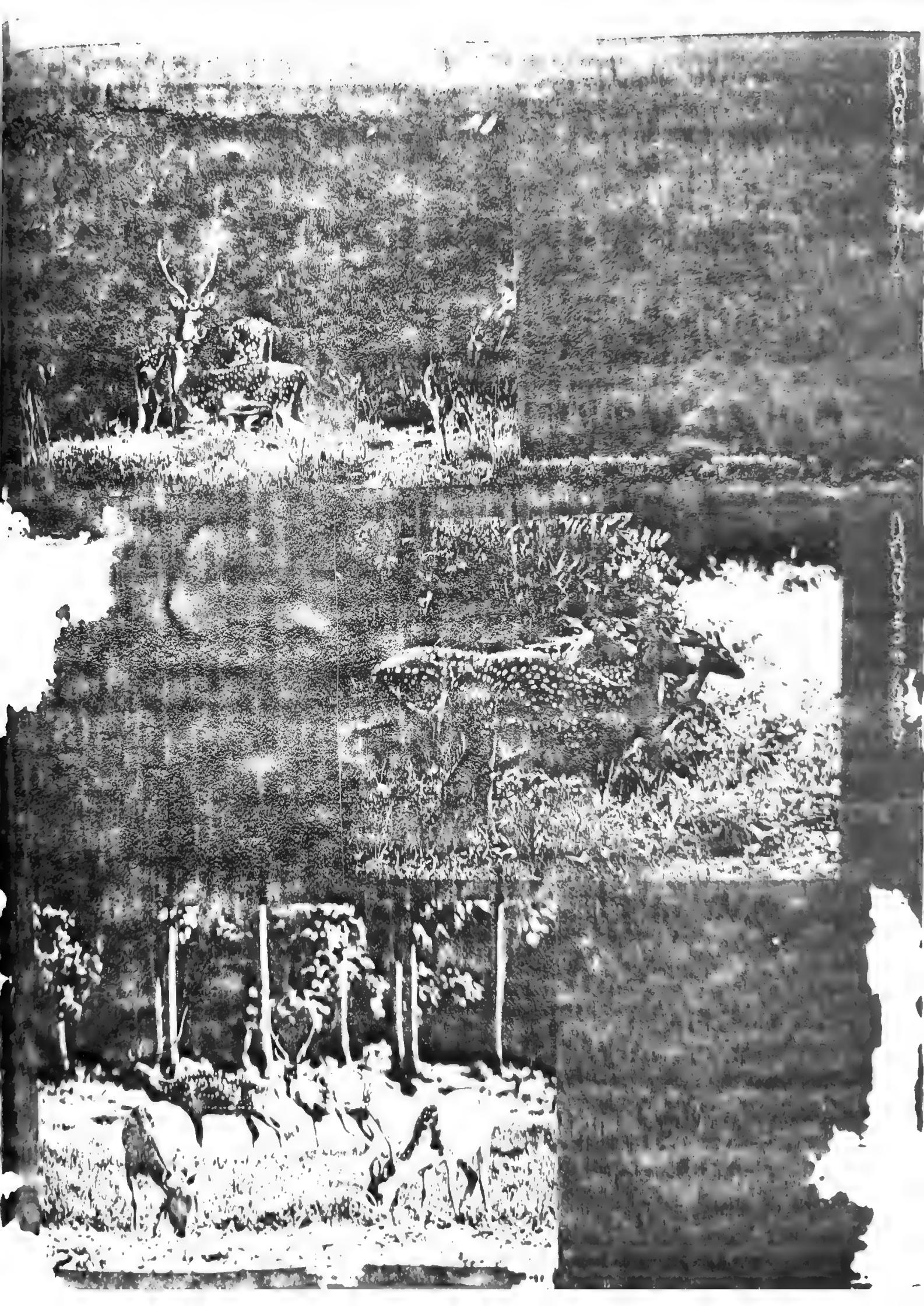
#### SPRONGING

This is a movement exhibited by all antelopes. (Moss, 1975). In this movement when animals are running they make a few leaps vertically high in the air by jumping and then all four feet touch the ground simultaneously. The action is repeated a few times. This behaviour was observed to take place just after they start running. It was noticed that this was a response when the animals were suddenly scared. Also in six observations, one of the animals of the sparring subadult (class III) spronged after the sparring grew a little vigorous. Therefore this could be a form of displacement activity elicited out of fear or alarm for it does appear like ritualised jumping which also

act as a visual signal when the behaviour is due to a predator. Many other hypothesis have been also put forth, like it aids in getting a better view and thus spot danger, the thumping hooves may act as an visual signal for danger or the animal may leave scent marks from its glands above the hoofs (Kosso, 1975, Schaller, 1967)

FIGURE 8

- I. A herd of Chital showing a mature stag, does, yearling doe and fawn.
- II. A herd of male Chital with antlers just growing.
- III. A Stag pawing the ground. Note the position of other male to which it is displaying, and also the tail position.



## V. THE CHITAL

## 1. DESCRIPTION

~~AXIN AXIN~~ commonly known as Chital or spotted deer is a medium sized deer. The male measures around 90 cm. at the shoulder (Prater, 1971). But the size is general declines from the north to the south of the Peninsula and also depends upon the terrain and flora (Krishnan, 1975). The coat is rufous brown with persistent white spots on the sides of the body with a dark line running from nape to tail and ear is white. A black band circles the muzzle. Does are often lighter colour than stags. (Figure, 8).

Stags start growing antlers from the age of 34 weeks which mature by 65 weeks (Graf and Nichols 1966). These simple spikes are about 12 cm. When these are shed after a year they grow the adult antlers which consists of a main beam forked at the summit and a brow tine which grow at right angles to the beam. The antlers are shed every year. The size of antlers increased with age, but in very old stags the size is said to decline. (Ditmars, 1919).

## 2.

## 2. PRICE REVIEW OF DISTRIBUTION AND STATUS

The Chital is the commonest wild animal of peninsular India (Krishnan, 1975). It occurs at the base of the Nilgiri and fractionally throughout peninsular India and Ceylon. It is unknown in the arid zones of the Punjab, Sindh, and in parts east of Bay of Bengal. (Prater, 1971). They do not occur in Kerala. They avoid thick forests and hilly rugged terrain and the availability of water limits their distribution. Schaller (1967) has given a survey of the occurrence of Chital in the Indian Subcontinent. Chital are highly adaptable and are very fast breeders and have been successfully introduced in other parts of the world like Hawaii (Graf and MacLean, 1971) and Andaman & Nicobar. The Chital present at the Guindy Deer Sanctuary is introduced (Krishnan, 1975).

## 3. DISTRIBUTION WITHIN THE SANCTUARY AND DAILY ACTIVITY CYCLE

Chital were encountered in all areas but its preference for a semi-open habitat to a habitat without a thick undergrowth or a thick canopy was noticed. They were observed in open habitat as the open field only after 1930 hours or early morning. Whenever the undergrowth was very thick Chital was not observed. This was also verified by the pellets present, but during the dry summer months from mid March to July they strayed into all the areas in the early morning upto 0930 hours for feeding. Also by now the undergrowth was thin.

The uniform distribution of deer in all the preferred areas by Chital indicated the high density of deer in the forest.

The daily activity cycle of feeding was similar to that observed by Schaller (1967), (Bharatchandra and Gadgil, 1975). Within the period of observation there was a morning peak of feeding from 0645 hours to 0845 hours and an evening peak from 1530 hours to 1900 hours. Temperature was the major factor that regulated the activity for they were observed in the open on dull cool days, but on hot summer days they retreated to rest under trees by 0815 hours or even earlier.

#### 4. POPULATION DYNAMICS

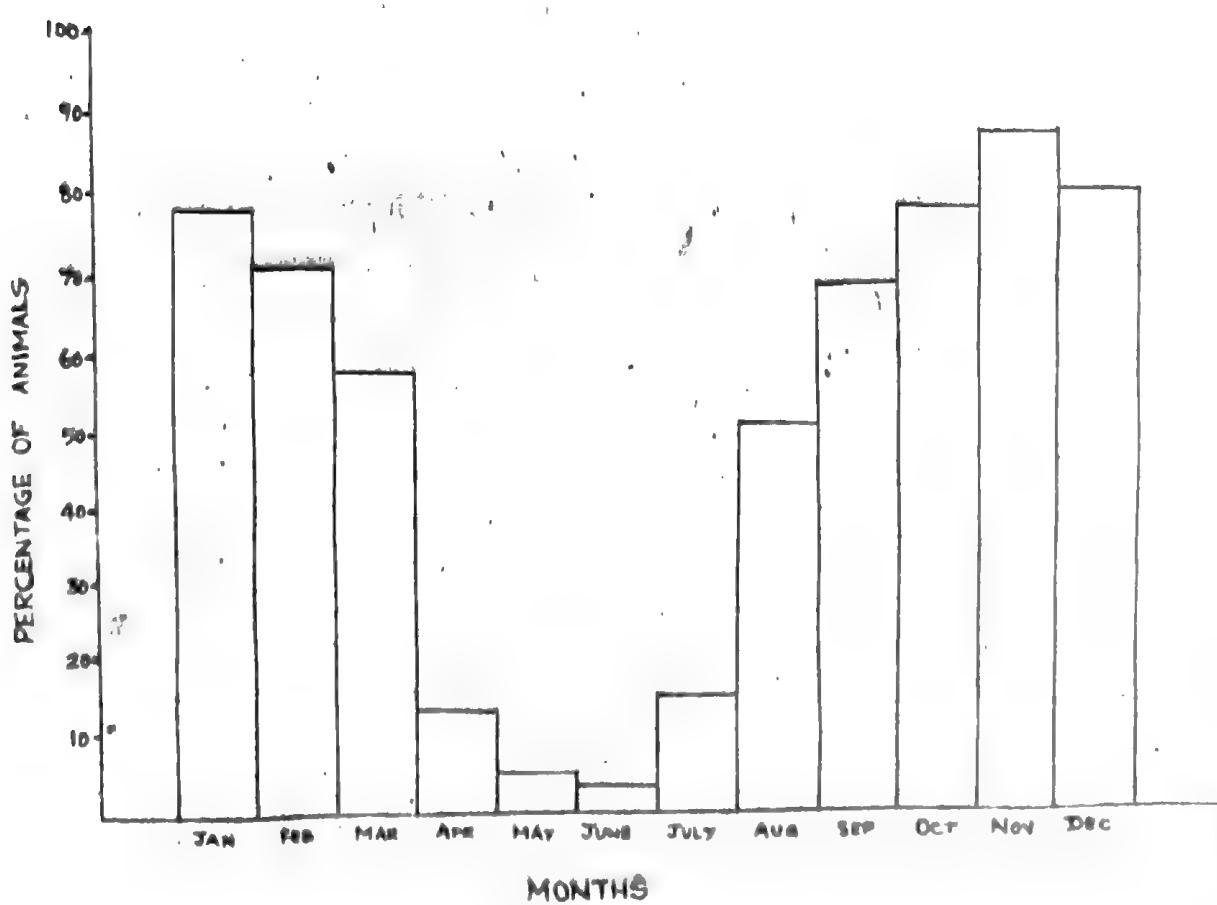
The estimated Chital population as on 17.3.1973 is 364. Chital was found in surrounding areas like the campus of the Indian Institute of Technology. No free movement was noticed between between the Sanctuary and the adjacent areas. This movement was not properly studied earlier but from the few observations made it was noticed that those coming in and leaving the Sanctuary area almost equal. It is reported by forest guards that Chital leaves the Sanctuary at night for feeding. A population of 364 Chital has been estimated within the Sanctuary and Table V gives the composition and percentage. This estimation may not be very accurate, but it shows the general structure of the population, present within the Sanctuary and adjoining areas.

#### SEX AND AGE COMPOSITION

The sex ratio between males and females is estimated at 77 : 100. This compares well with the figure of 77 : 100 (Ritchie, 1970) in Hawaii and an average of 70.5 : 100 (Chatterjee, 1967) for India, but, sampling techniques might have overrated males and under rated females.

The percentage of yearling was only 20% of the whole population and the fawns make up 27%. This is too low for an healthy population. Taking the figures of the Forest Department for mortality into account which totals to 72 for 1977 and 107, the birth

## PERCENTAGE OF ADULT STAGS OBSERVED IN VELVET.



SELVAKUMAR

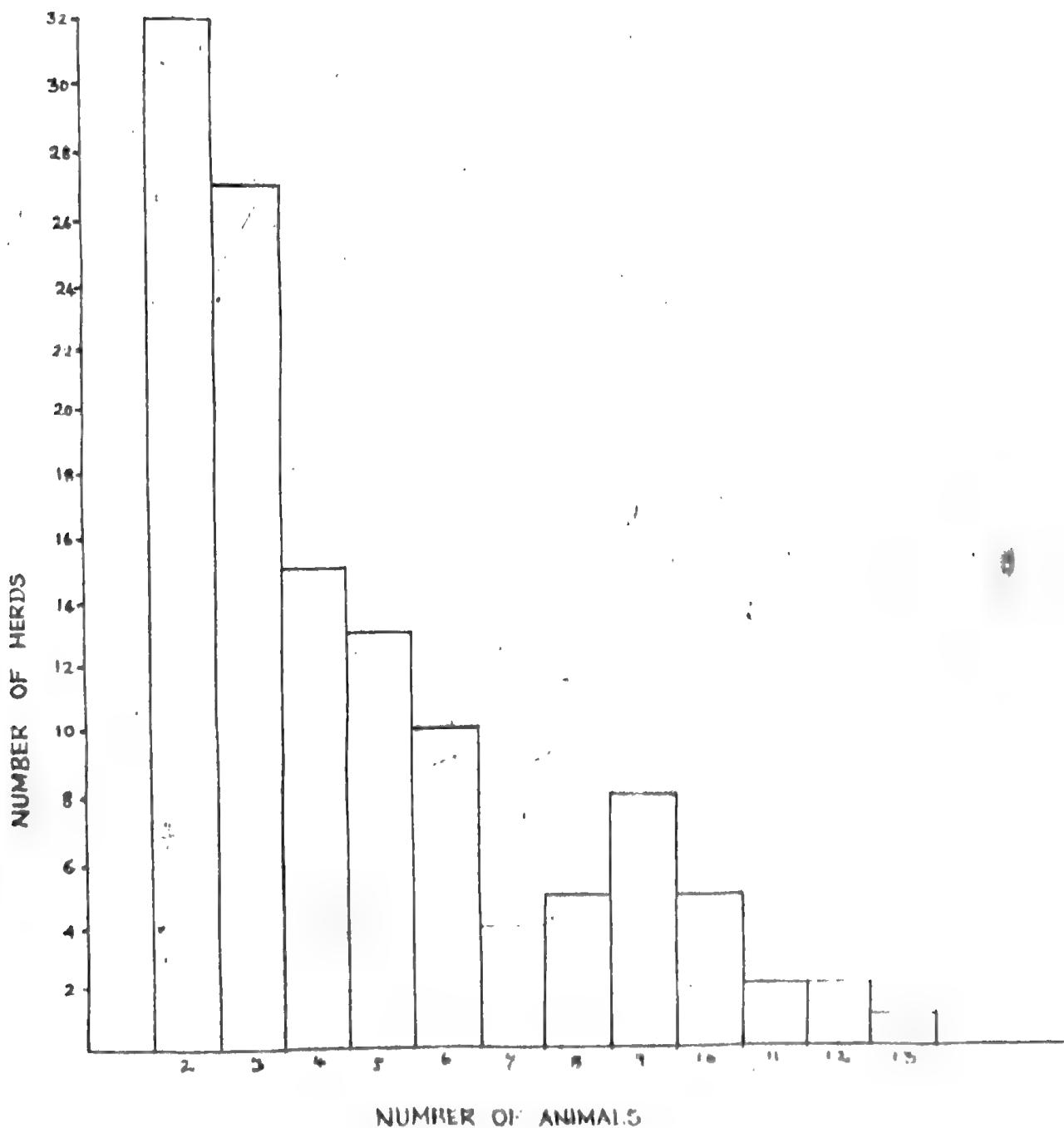
offsets even though the adult ratio is very high and suggests at least theoretically a declining population. But since exact account of adult yearling and fawn ratio could not be kept throughout the year this conclusion is very tentative.

#### THE BREEDING SEASON

Though stags in hard antlers were found throughout the year, the percentage of stags in velvet increased from August when many were noticed in pedicels to February (Figure, 9) by February most were fully grown antlers. Though a few with halfgrown antlers were noticed in February, 60% of those were two to three year olds in which the antlers are 60cm. By the time the older stags had their big antlers fully grown those would also have their set of hard antlers. This suggests that older stags with larger antlers tend to shed them earlier than the younger stags. The percentage of those in hard antlers increased from the end of March till July. Also the loud rutting call was heard in increasing frequencies from the end of March to July. Krishnan (1975) states rutting call may have a other social function, though it connected sexual function also. No stag in velvet was observed to bray. The call increased during the rut.

"New fawns were observed between end of January and April. It was noticed that the majority of those observed in April to May were two to three months old suggesting they had been born around February. The gestation period is about eight months (Challier, 1967) and one young in proportion per female."

NUMBER OF ANIMALS PER HERD OF A  
REPRESENTATIVE OF 125 CHITAL HERDS.



Correlation of antler growth, rutting calls and birth of fawns all suggest that there is a peak of reproduction for the Guindy Chital population. This falls between mid April and early July with a peak between May to June. These cycles generally agree with Graf and Nichols (1966)(Bohaller 1967) Sharatchandra and Gadgil (1975) but disagree with Krishnan (1975) who noted that Chital have no rutting season.

Thus fawns born between December to early March would be faced with an acute shortage of food between May to July. This would affect the lactating female also and consequently mortality would be high. This probably does not happen because of grass put by the Forest department, thus contributing to the high density for Chital.

#### HERD COMPOSITION

The most permanent association seemed to be a female, fawn and yearling. Females and yearling fawns stayed together for the longest association, and one female and its yearling was found together for a period of 21 days. Next was the males which were in pedicles which generally kept together in two 's'. The males particularly during the antler/growing season was found to form herds numbering from two to three. But in other seasons they associated with females but formed loose associations. Lone stage were observed on many occasions and associations with other members was not permanent and differed from day to day. (Figure, 10). shows the number of animals per herd of a representative of 125 herds.

Generally they were found to associate in more numbers during the evenings after 1700 hours. When forage was good they associated in more numbers than otherwise. It was noticed that when grass was provided they associated in herds numbering upto 37 individuals even before forage was put. Therefore food availability seems to be an important factor in the number of individuals per association and this is particularly a reason why Chital in bigger congregation are not met at the Tadoba Sanctuary. The absence of a predator could also be another reason as (Baratwanayya and Gadgil 1975) have noted that herd gregariousness is an antipredatory device. This combined with food availability limit to Chital herds at Banigar.

#### BEHAVIOUR

The general behaviour observed were similar to those observed by (Craf and Nichols, 1966) (Bohnillor, 1967) (Baratwanayya and Gadgil, 1975) records of homosexual mounting which was not observed. 'Conistic displays increased at the feeding site in summer which may either because of the rut or because of the congregation. Craf and Nichols (1966) also record of males exhibiting a sort of territorial behaviour. This was not observed here.

TABLE VI  
PREFERENCE OF TREE PRODUCE EATEN BY GIANT

PLANT	PARTS EATEN	PREFERENCE
<u>Acacia planifrons</u>	Leaves Pods	++ ++
<u>Acacia xanthophloea</u>	Leaves Fruits	++ ++
<u>Acacia senegal</u>	Seeds	+++
<u>Mangifera indica</u>	Leaves	+
<u>Acacia farnesiana</u>	Leaves	+
<u>Ficus benghalensis</u>	Fruits	+++
<u>Caesalpinia cornuta</u>	Pods	+
<u>Tamarindus indica</u>	Pods	++
<u>Anodirachis indica</u>	Inflorescence fruits	++
<u>Phoenix sp</u>	Inflorescence fruits	++

## 6. FOOD HABITS

Chital was observed to prefer green to brownish. This however, varied with the seasons. In the winter months they were found feeding on grasses like Chloris sp., and was supplemented by browsing on herbs as Loropetalum blondo and Carica carica. The last two species were highly and highly preferred to other shrubs. Aegiphila planifrons was also taken. It was observed that when spread for a became scarce they also fed on the leaves Ziziphus xyloxylo, Sida cordifolia, Momordica indica, Vitis bengalensis, Catalpa binata, Psorospermum indicum, Glycosmis coccolinifera, Aegiphila planifrons. In Croton marginata only the seeds were eaten and the outer shell was discarded. Table 6 presents the preference of the tree products eaten.

In addition it was observed in the dry months, they were highly selective and fed off fallen vegetation, picking them up by sniffing close to the ground. This variety probably provided them with enough nutrients during the lean period. The Forest department in summer from mid April May to July provided them with Alpha alpha grass distributed in seven areas. When Ficus bengalensis was in fruit they often associated with Bonnet monkey (Macaca radiata) picking

up the onlyx, fruits that the monkey dropped.

In spite of the fact that the flight distance was reduced, Chital exhibited the same cautionfulness when going down to drink as water was found in their natural habitat as in "Vidarbha" where predators are present.

## VI. DENSITY AND BIOMASS

The density for Chital works out to  $107/\text{km}^2$ . This figure if extrapolated for  $100 \text{ km}^2$  works out to  $10700/100 \text{ km}^2$ . If compared with  $2170/10 \text{ km}^2$  for Salaman,  $265/100\text{km}^2$  for Bandipur,  $1586/100\text{km}^2$  for Kanha,  $316/100\text{km}^2$  for Sunderbans, (Tonkhalia, 1979) the density is very high.

The Blackbuck density is also high which works to  $74/\text{km}^2$  or  $7400/100\text{km}^2$ .

Taking the biomass into consideration for a start using Schaller(1967) weights we estimate a total 18,541 Kg and for Blackbuck taking 29 Kg as average weight, 7,547 Kg are obtained. Put together both Ungulates show a biomass of  $7451 \text{ Kg}/\text{km}^2$  and with the dozen cattle, the biomass of the whole park is  $9,166 \text{ Kg}/\text{km}^2$ . Schaller(1967) has estimated a total biomass of  $3,693 \text{ Kg}/\text{km}^2$  that Kanha could potentially support after the exclusion of cattle. This included all species of wild ungulates that occur at Kanha. Powell and Morton, (1971) have estimated a biomass of  $5.6 \times 10^5$  lbs for Gir. Taking these into considerations, a biomass of  $9,166 \text{ Kg}/\text{km}^2$  definitely seems to be very high.

50.94 Kg

## VII. DISCUSSIONS

1. ON TERRITORIALITY IN BLACKBUCK

During this study all displays connected with territoriality were very commonly observed. Such epideictic displays (Wynne-Edwards, 1964) were probably present because of the very high density and the close approximation of territories. When a visit was made to Point Calimere agonistic displays were rare and Nair (1972) reports no marking of preorbital glands. This is because the population of Point Calimere is not dense and is well spaced. Schaller (1967) reports the central area of Blackbuck territory at Kanha was about 20 acres and that the two male's territories were spaced about a mile apart. Small territories are present here because the population is dense. Since the males occupy territories so close the number of displays are also intensified.

" Few territorial behaviour is species feed in their territories, and it is doubtful whether territorial behaviour is important in maintaining a food supply or in limiting numbers ". (Lack, 1954).

It has been observed that while the Polo field provides forage for a good many Blackbuck the males leave area for feeding, though during the rut nearly 65% of the observed time from 0630 hours to 1830 hours the male were in their respective territories. Apart from the rut, males exhibit dominance hierarchy between mature territorial males was observed in the present study. But Schaller (1967) notes the presence of linear dominance hierarchy among the mature males. Each dominant

in it's territory and the relationship was related both to time and space. Even during a single day, bucks exhibited dominant behaviour at certain times, especially when females were present but the intensity varied. It was noticed on dull cloudy days bucks did not exhibit strict territoriality but became actively territorial as light intensified.

Excepting on two occasions all herding and courtship displays were observed only within territories and in the centre of it. Therefore for wild Blackbuck a territory is necessary for breeding and this probably places a check on the population from increasing at a very rapid rate.

It is only in the Uganda Kob Adenota kob that a monnic pattern of territory has been observed in antelopes. (Buechner, 1961 Moss, 1975). Though in the Uganda Kob, males holding territories in the centre of the mating ground one said to loose their territories in two or three days, but those in the periphery possess them for longer durations. Though no such pattern was observed in the Blackbuck the close packing of territories does approach the kind of a territorial system present in the Uganda Kob.

### ECOLOGICAL CONSIDERATIONS

The habitat preference of the two ungulates was clear even in this small area. The Blackbuck stayed almost completely in open areas, excepting during the summer months when they spread out. Also they are observed to be highly tolerant to direct sunlight and are mainly a diurnal feeders. They retreated to shade only in the hottest months, but even then rarely entered thick bushes. Therefore the availability of open areas and grass for forage limits the distribution within the Park. Also, open areas are important for breeding and therefore the maximum population the Park could have, would probably be dependent upon the open areas available.

The Chital was observed in semi-open up to and found where shade was present. Though they were observed in open areas nearly in the evenings, dull or on cool damp they seem to need shade for resting. They were found feeding in the early morning and late evening. In between, feeding is over is cursor, unlike the Blackbuck which is diurnal. This is also primarily a cursor though it supplemented its diet with browse when forage was low. They were not observed in thick undergrowth especially during the cool months. Therefore in this species, temperature, shade and grass availability and factors controlling its distribution. They were also seen to drink water regularly unlike the Blackbuck.

### ETHNOLOGICAL COMPARISON

Social structure and communication are the means of fostering survival of a species through allowing the survival of individuals and groups by decreased energy expenditure and a division of labour (Collier, 1971). Schaller (1967) has compared the basic behaviour of both ungulates at Kanha National Park. Those not discussed by him are considered here.

#### (a) On the antlers and horns:

Both the ungulates of the Bwindi Impenetrable Forest have a well established social structure. This system at least in the males of both species are dependent upon secondary sexual characters, the horns and antlers. In Blackbuck the horns are species of ciblo and are permanent. The bucks attaining their mature horns by the end of the third year. In Chital they are by and large individual specific, deciduous and are highly variable.

Various reasons have been given for the function of antlers. Intraspecific defense and physiological explanations (Modell, 1969) have been put forth. Here an ethological answer is attempted for the deciduous nature of antlers. Antlers were found to be directly responsible for the social hierarchy and horn shedding is an advantage as it confers maximum variability to it, as the pattern changes from year to year. Also the general fitness

of the Stag is reflected by the nature of antlers, and hence are the "Status symbols of dominance" (Schaller, 1967). In old bucks the antler size decline and because of it is the reproductive function is hedged towards the younger healthier males. Lorenz (1952) noted that in general the more lethal an organ the less is its use against conspecifics, in the agonistic interactions taking place in the form of displays. This was found to be true in Chital and stags accepted the size of antlers as signs of dominance and fighting was minimal. In stags having large antlers, "ignorant sparring was seen mainly among stags those antlers were not large but occasionally intense fighting did erupt but was never lethal.

Also in this study Chital were not observed to exhibit territorial behaviour and the fluid nature of herd composition was noticed. Stags in herd antlers rarely associated for long durations. Chital have an inherent quality for gregariousness, but the herd composition keeps on changing and stags have never been observed to be in permanent association. This would lead to intense intraspecific fighting were it not for the deciduous nature of antlers which provide a high degree of variability antlers used as status symbols by which they judge each other with minimal antler size. Also in the case of broken antlers, the importance of the deciduous nature is obvious. From this it is clear that the deciduous nature of antlers, is the underlying factor in the social structure of this deer.

Dominance is relative in the case of mature territorial Blackbuck. The growth and maturity of horns are almost equal. In Blackbuck the cohesive unit of subadult and non-territorial bucks was noticed and because of continual contact with each other a clear social hierarchy is established. This would ultimately limit severe mature adult fights though adult fighting were present. Dominance in mature bucks is expressed in the form of territory which is related to both time and space. Thus the blackbuck in its own territory was 'alpha' but not outside its territory. No case of an absolute hierarchy was observed in territorial bucks.

Thus in spite of them asserting dominance through structures which are almost equal in all mature males the nature of the social system in Blackbuck is such that it probably does not require the high variability of these structures as Chital.

#### (b) Reproductive :

According to Ithkin (1964) dimorphic males usually take no part in the protection of young and are biologically expendable in the economy of the species. This is true in almost all Ungulates which are dimorphic. In the Blackbuck this is carried to the extreme. Territorial bucks themselves function as a visual marker and its pelage colour clearly stands out. The colour pattern may also be a visual stimuli for aggressive behaviour. In males holding territory aggressive nature is high which causes the head up to be performed, when another mature

blackbuck intrusion. In the case of the female this hooding is probably suppressed due to the brown colour and instead the head-tilt display where the horns are depressed over the back is performed accompanied by grunting. This is probably the reason why yearling bucks are like females in colour and because of this the intensity of aggressive behaviour directed towards them by mature males is reduced. Here the distance is crucial for "the essential feature of any of the territorial systems is that the stimuli which release aggressive behaviour of the territorial animal are not simply those from the conspecific but include the position of both animals on fixed space." (Ho Bridge, 1971). But here visual stimuli plays a significant part in aggressiveness and distance is inversely proportional to the size of the adult male, for in older subadults the horns become prominent.

In comparison the Chital have a coat which is not appreciably different in the two sexes, and plays no part in dominance assertion. The antlers body size and posture being the criteria of dominance, though in rutting stage a darkening of the neck region was noticed. Though they exhibit an inherent quality for aggression, "individual distance differential" (Lehman, 1971) was observed mainly in herd antlered stage. None of this aggression once mature the dominance was absolute unlike the blackbuck which is in relation to a particular area. Chital did not exhibit territoriality but personal space was important irrespective of the area. Also the pelage is an effective camouflage as they inhabit forests, unlike the Blackbuck.

## VII. CONCLUSION

In both the species studied a social structure is evident which enables the species not only to survive but also make it distinct and unique from the rest of the animal species.

In the Blackbuck territory is probably an impelling factor involved in reproduction and hence population growth. This system closely agrees with the hypothesis of Wynne-Edwards (1960) who suggested intrinsic population control mechanisms. But the system has proved to be adaptive. This is clear if the size of Blackbuck territories present at Guindy are compared with those of Kanha (Schaller, 1967).

On the other hand, in Chital no behavioural characteristic suggesting population pressure has been observed. Badlier (1962) has suggested the possibility of density having an effect on the physiological processes of reproduction, and also the level of nutrition is said to have detrimental effects on reproduction. But what these effects are, not clear.

The present study has to be viewed against the time involved in actual field observation which is inadequate for accurate conclusions. But the study indicates epidemic behaviour in Blackbuck and the density and biomass is very high, probably the highest for any sanctuary in India. Long time research would be needed to evaluate exact population trend, and plant herbivore relationship and to estimate the optimum population the Park could naturally support.

## SUMMARY

The present work is an attempt to study the behavioural ecology of the Blackbuck and the Chital-two mammals of the Guindy Deer Park Sanctuary. The study included regular biweekly observations extended over a period of eighteen months. The work included an ecological survey of the park that supports the population of these two mammals. It also includes population studies, and theological studies seeking to analyse their basic behaviour patterns, social organisation, foraging and breeding behaviour including 'territoriality'. The 'focal study' method was adopted for the study of the blackbuck. The ideotetic behaviour exhibited by blackbuck is discussed. New findings like the absence of a heron, absence of hierarchy in territorial males for the Blackbuck and the possible existence of a breeding season for the Chital not reported by many earlier workers is recorded. Also new explanations for 'uprooting' and theotheological significance of the shedding of the antlers in the Chital and dimorphism of Blackbuck is given. The density and biomass of the ungulate population is also discussed.

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